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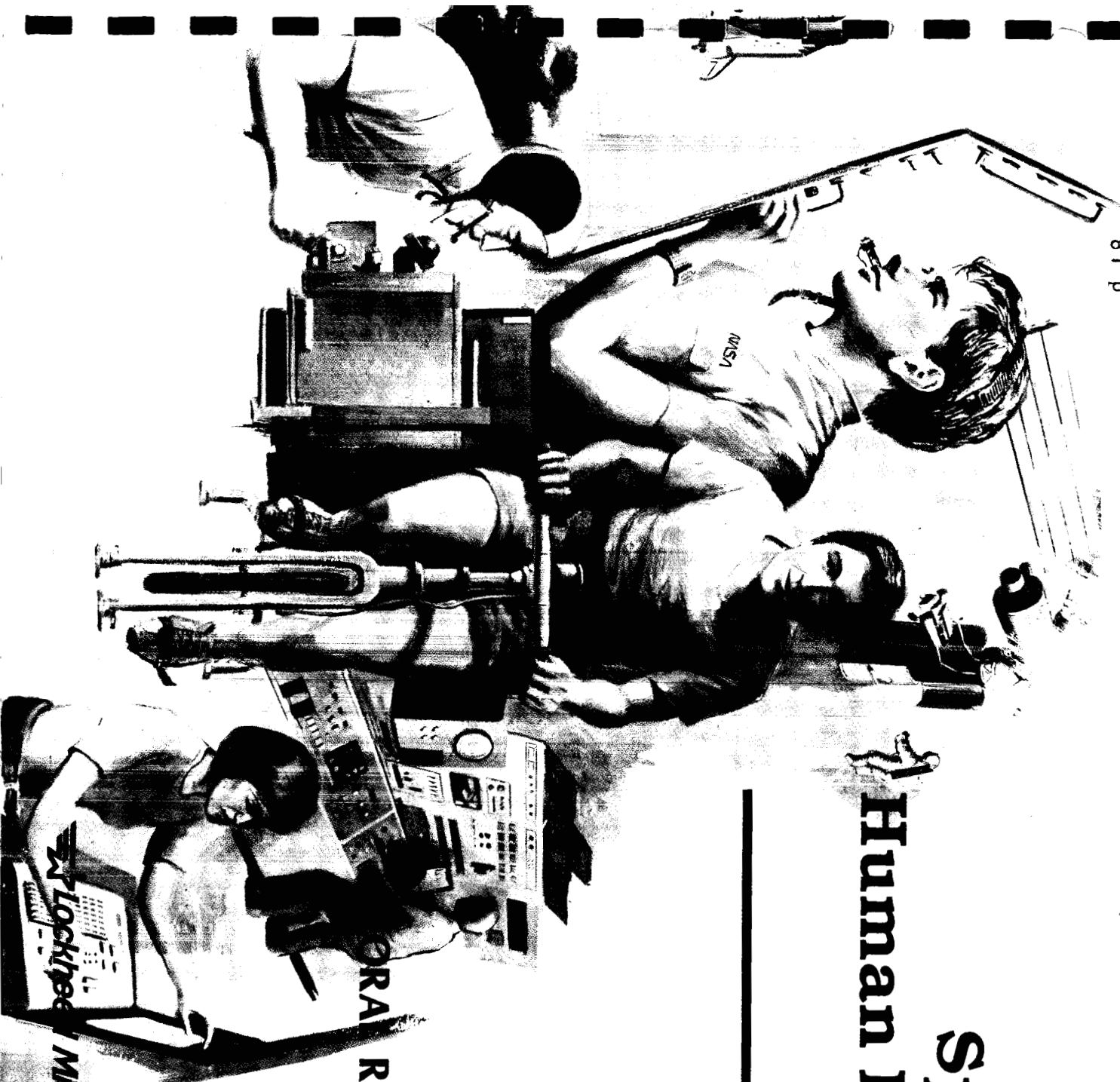
LMSC F060784/2
NOVEMBER 1985

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Space Station Human Productivity Study

FINAL REPORT
VOLUME II

EXECUTIVE SUMMARY
AND
CHAI REVIEW PRESENTATION



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Space Station Human Productivity Study


FINAL REPORT VOLUME II

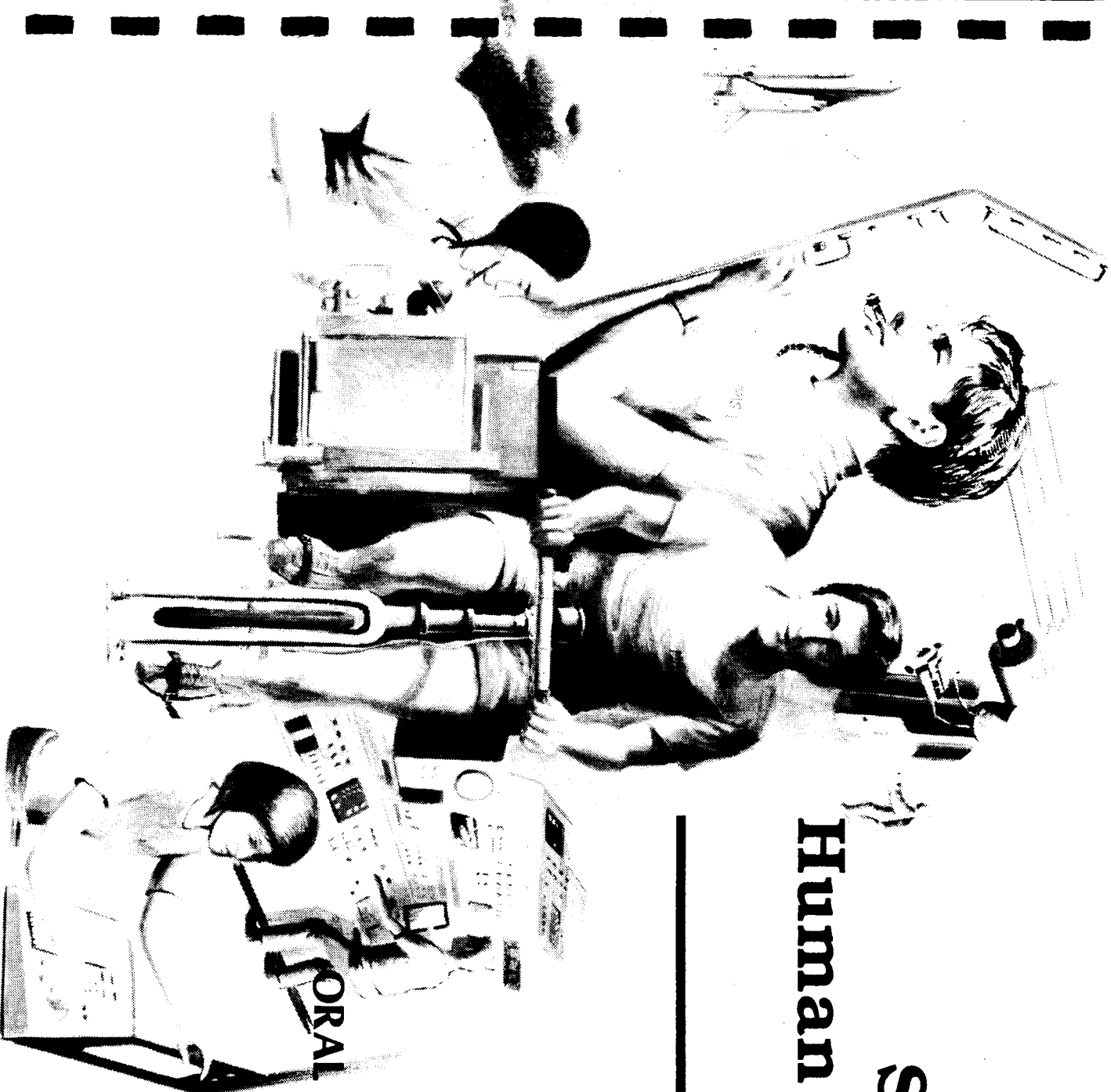
EXECUTIVE SUMMARY AND ORAL REVIEW PRESENTATION

CONTRACT # NAS9-17272
DR SE-1093T

PREPARED FOR
MAN-SYSTEMS DIVISION
NASA Lyndon B. Johnson
Space Center

BY

 Lockheed Missiles & Space Company, Inc.



FOREWORD

This volume is one of five for the Space Station Human Productivity Final Report. The five volumes are:

- I — Final Report (Study Description)
- ➡ II — Executive Summary and Oral Review
- III — Requirements
- IV — Issues
- V — Study Management Plans

INTRODUCTION

Study Team

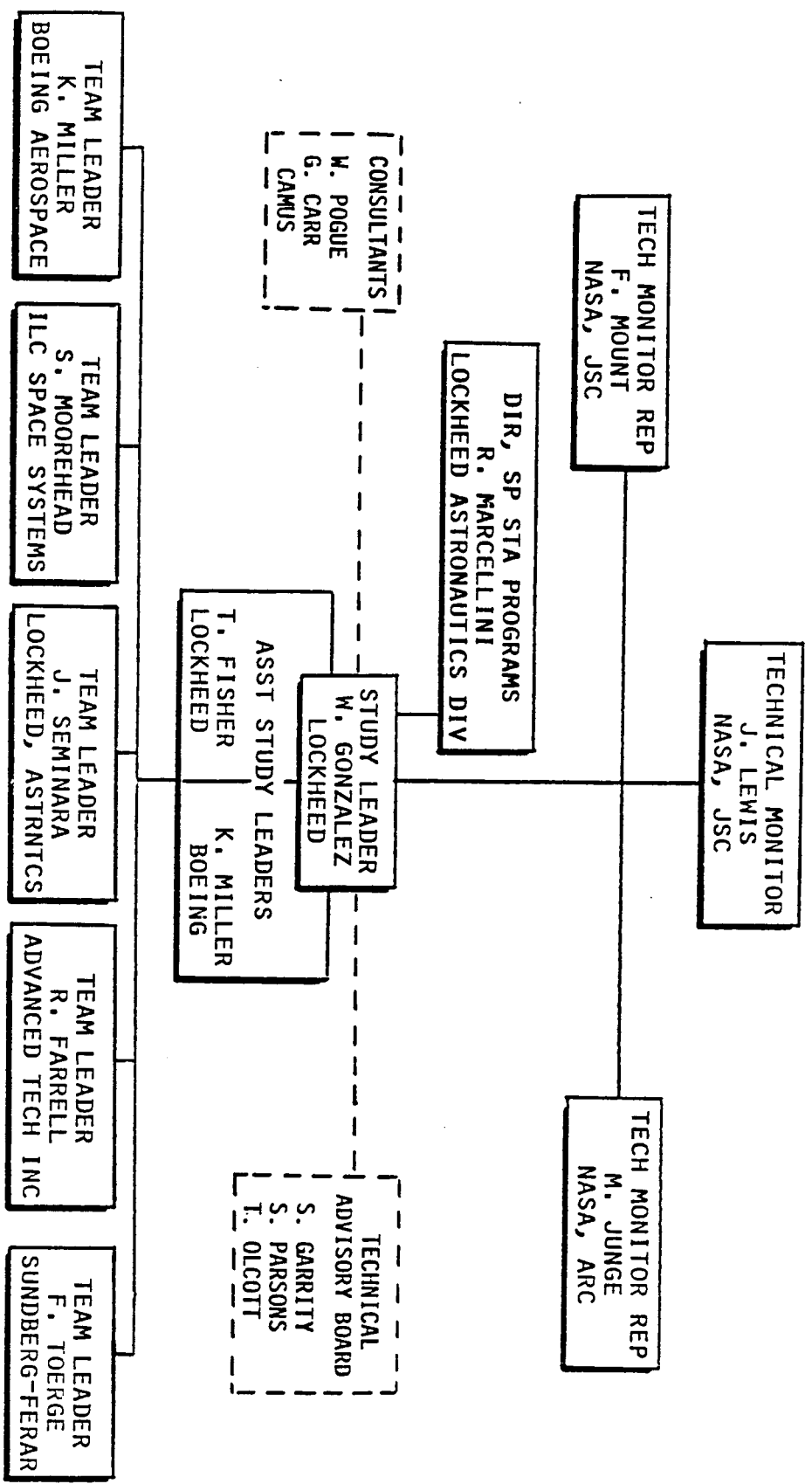
The Space Station Human Productivity Study (NAS9-17272) was awarded in November 1984, as one step in the overall NASA program to maximize human productivity in Space Station operations. This chart shows the joint NASA-contractor team for the study. Approximately 36 contractor analysts participated in the effort, supported by contributions from several NASA offices and from recognized experts in their respective fields.



SPACE
STATION

STUDY TEAM

Human Productivity Study



STUDY OBJECTIVES

The scope of the study was limited to Intra-Vehicular Activity (IVA) and IVA interface with Extra-Vehicular Activity (EVA). Other awards were made for a similar study in EVA operations. This chart shows specific objectives of the Space Station Human Productivity Study.



STUDY OBJECTIVES

Human Productivity Study

SUPPORT SPACE STATION

1. DEFINE DESIGN/OPERATIONS REQUIREMENTS FOR SUPPORT OF HUMAN PRODUCTIVITY
2. IDENTIFY PROBLEM AREAS LACKING DATA FOR REQUIREMENTS DEFINITION
3. GENERATE MANAGEMENT PLANS FOR CONDUCT OF STUDIES TO ACQUIRE NEEDED DATA FOR TIMELY SPACE STATION PROGRAM IMPACT
4. CORRELATE ALL ISSUE STUDY MANAGEMENT PLANS WITH SPACE STATION PROGRAM MILESTONE NEED DATES.

STUDY APPROACH

The study approach was structured to achieve:

- Identification of Space Station elements (IVA related) that affect human productivity
- Generation of requirements for those elements in support of crew productivity
- Identification of problem areas, initially recognized as unresolved requirements, and consolidated as study topics called Issues
- Recommended approaches for the performance of needed studies, called Management Plans

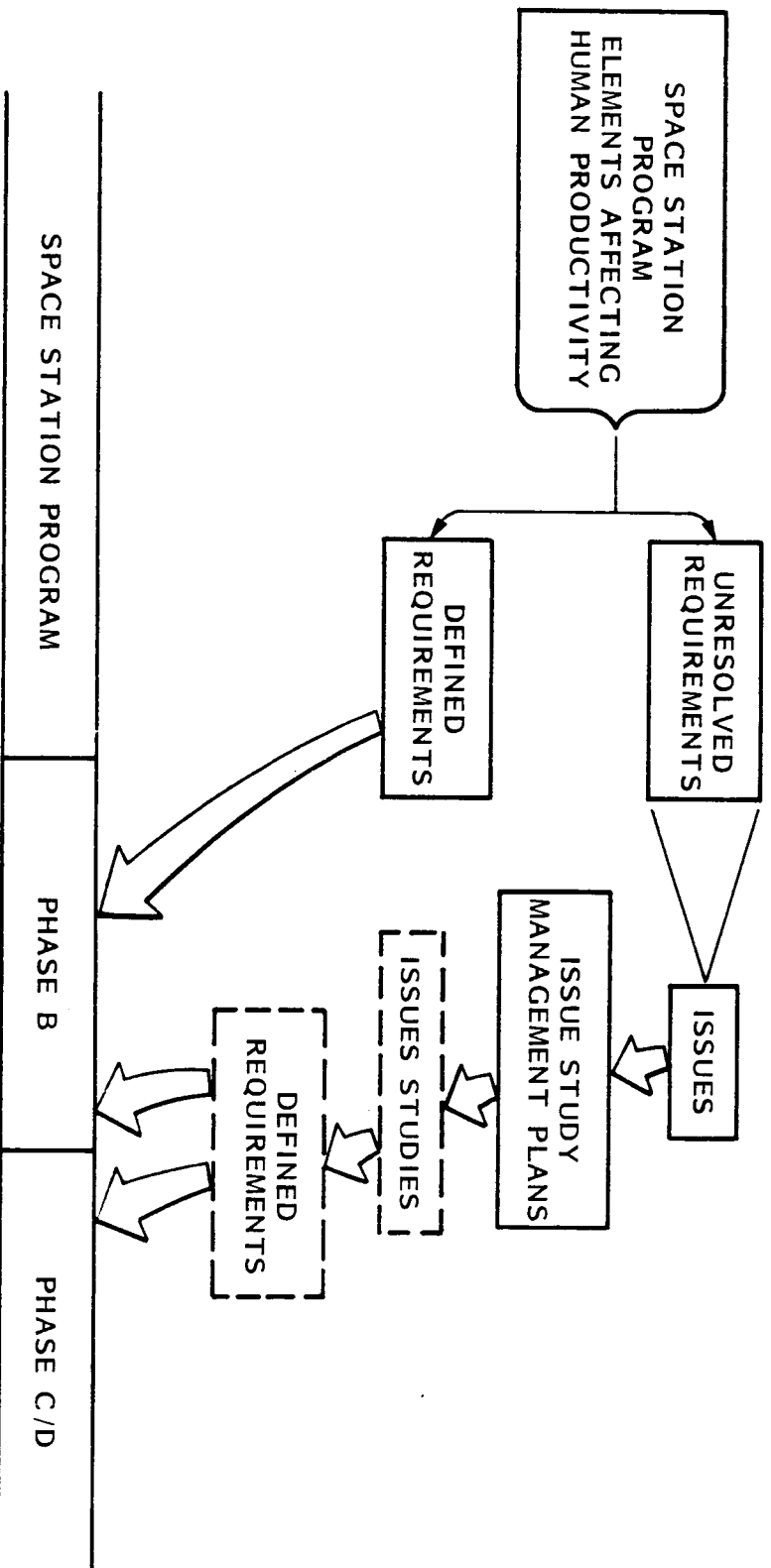
NASA will complete the definition of unresolved requirements, following performance of the recommended (and associated) studies. Study schedules were defined to achieve results for timely inputs to the SSP.



**SPACE
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STUDY APPROACH

Human Productivity Study



TECHNICAL APPROACH OVERVIEW

The study began with a literature search which continues to support tasks throughout the study. Aspects of Space Station design and operation which could affect on-board Human Productivity (HP) were selected according to defined criteria. This served to scope the topic matter. Requirements which could be justified by existing data were then defined.

In many cases, candidate solutions are offered by the originating analyst, but do not carry a NASA sanction. Specific critical assumptions about design or operations were documented in order to proceed with specific requirement statements. References throughout the study were fully documented. Data gaps led to the incorporation of preliminary or unresolved requirements. All data appears in the Requirements document (Volume III) of the Final Report.

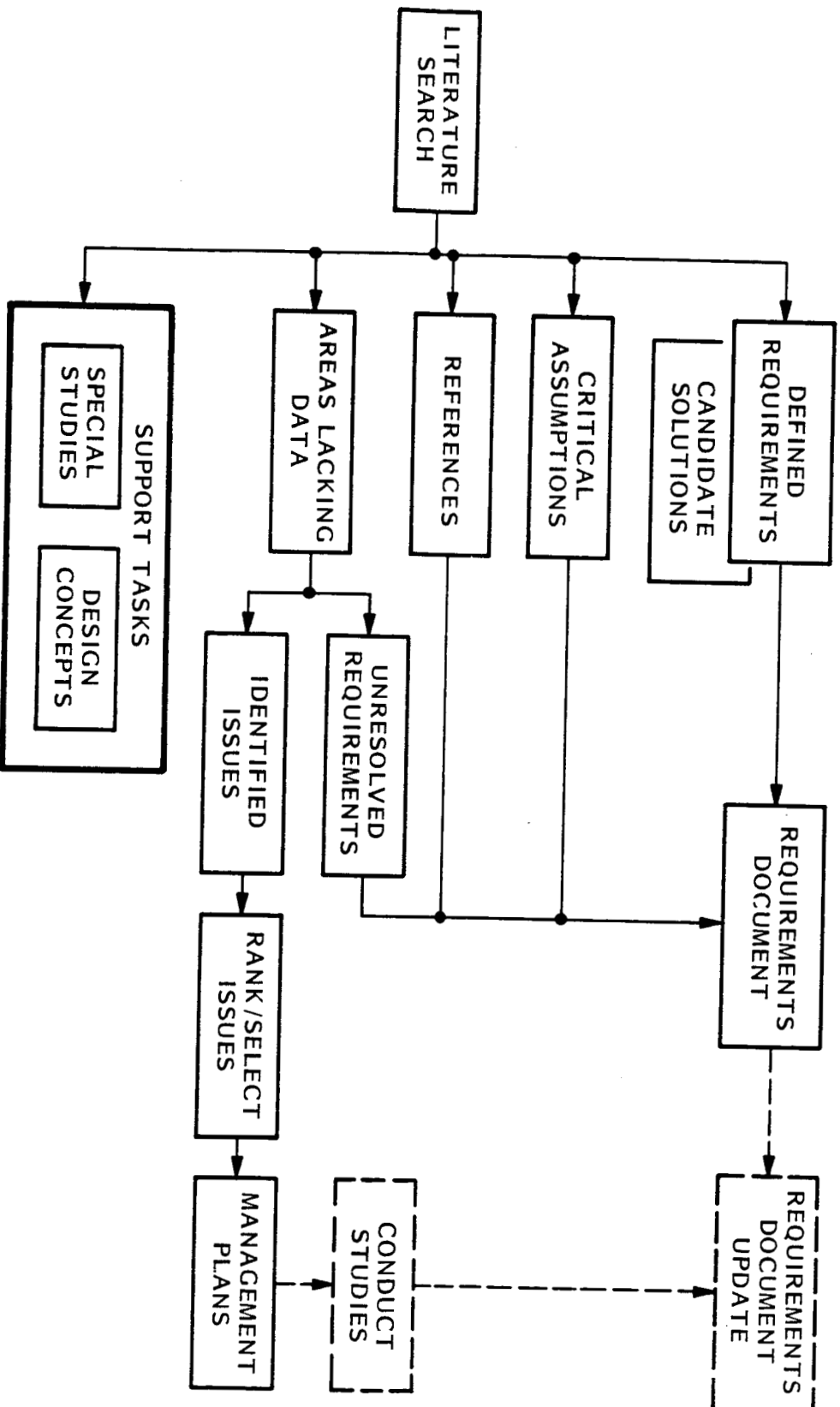
Recognized study needs are described as Issues (Volume IV). They were extensively reviewed and assessed for importance by a joint NASA-Contractor team. Management Plans (Volume V) were then written for selected Issues for performance of the studies. Requirements (Volume III) will be updated by NASA when studies are completed.

Support tasks provided for any needed special trade studies, such as for selection among critical assumptions, and for generating design concepts as needed to support the description of Issues.



TECHNICAL APPROACH OVERVIEW

Human Productivity Study



DATA MANAGEMENT SYSTEM

The large amount of data was compiled and integrated through the use of a networked Personal Computer (PC) system. The depicted architecture allowed generation of data files and standardized data report formats. Day-to-day messages and minor data updates were data-link transmitted. More extensive data transmittals were handled by mail exchange of diskettes or tape.

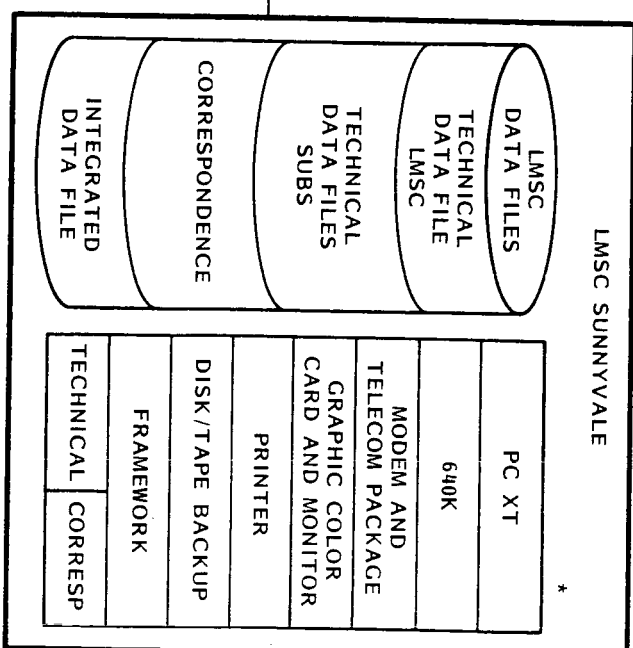
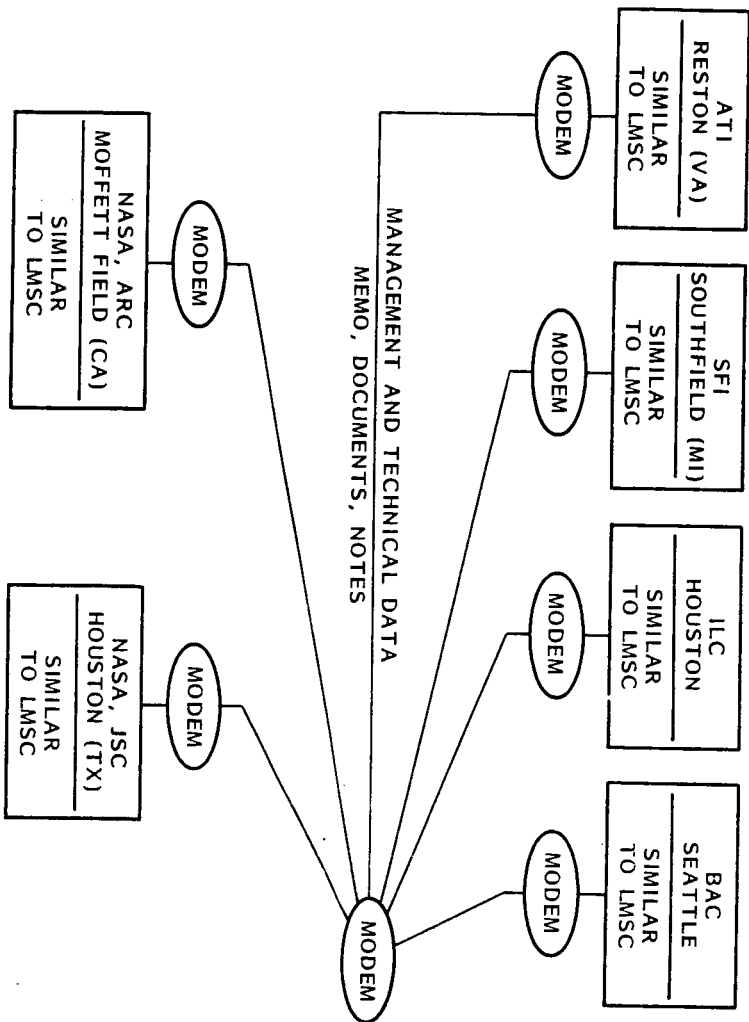
The system is recommended for similar data integration applications, but an expanded-capability data base system is needed for efficient user access. Such an approach is described later.



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DATA MANAGEMENT SYSTEM

Human Productivity Study



*INCLUDES:
HAYES (1200) BAUD) MODEM
TURN-ON (H/W AND S/W) TELECOM PACKAGE
AST 6 PAK-PLUS EXPANSION CARD WITH CLOCK
DAYONG 40 M-BYTE DISK WITH TAPE BACKUP
DOS 2.0 (OR 2.1)
FRAMEWORK
APPLICATION TEMPLATES

TECHNICAL APPROACH TASK FLOW

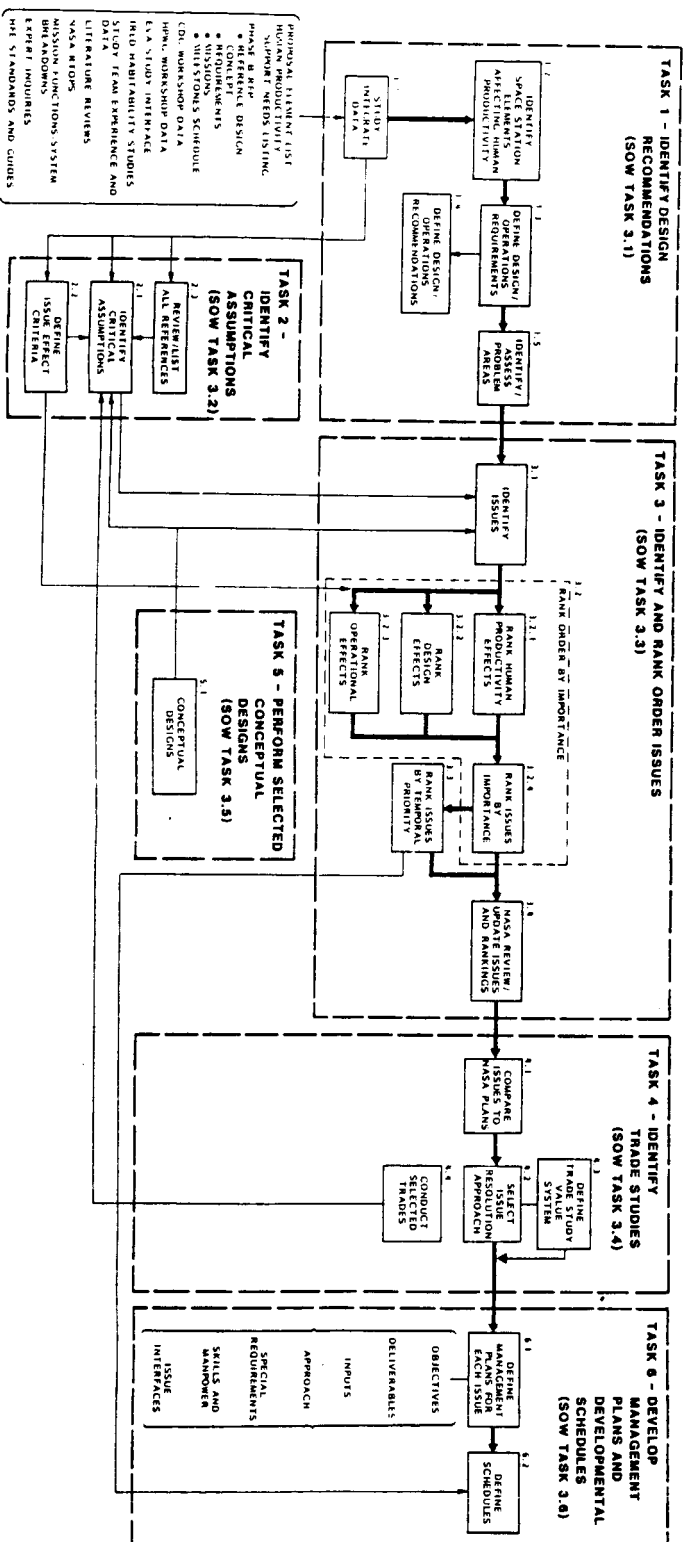
The Technical Approach Task Flow is shown for reference purposes only. Each of the tasks and related activities are detailed in the following sections.



**SPACE
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TECHNICAL APPROACH TASK FLOW

Human Productivity Study



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TASKS 1 AND 2

Task 1, Identify Design Recommendations

The subtasks began with a survey and integration of study data, drawn from all available, reasonable resources. Following the identification of which Space Station elements affect human (crew) productivity, Requirements and Candidate Solutions were written. Pursuit of these tasks led to the identification of problem areas, or "unresolved requirements", caused by the lack of adequate data.

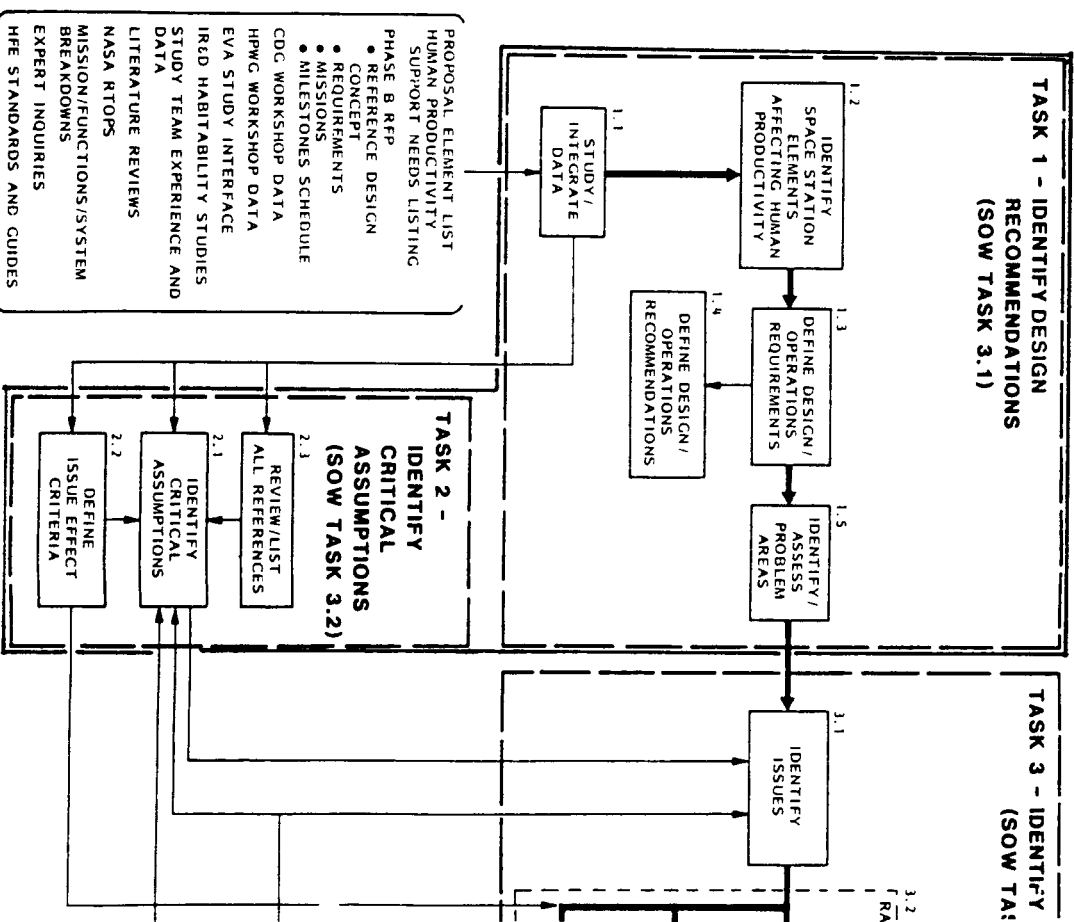
Task 2, Identify Critical Assumptions

Subtask 2.1 called for documentation of the needed critical assumptions. Subtask 2.2 required the definition of criteria utilized in ranking the Issues for Task 3. The third subtask was defined for review and documentation of all data references.



TASKS 1 AND 2

Human Productivity Study



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TASK 1 — IDENTIFY DESIGN RECOMMENDATIONS

A preliminary concept for organizing and identifying Space Station elements affecting human productivity was drawn from work performed by the NASA Headquarters sponsored Human Productivity Concept Development Working Group. The chart shown extracts Common and Steering Elements, and includes EVA Systems not scoped for the present study. The HP Study then sought to refine this listing.

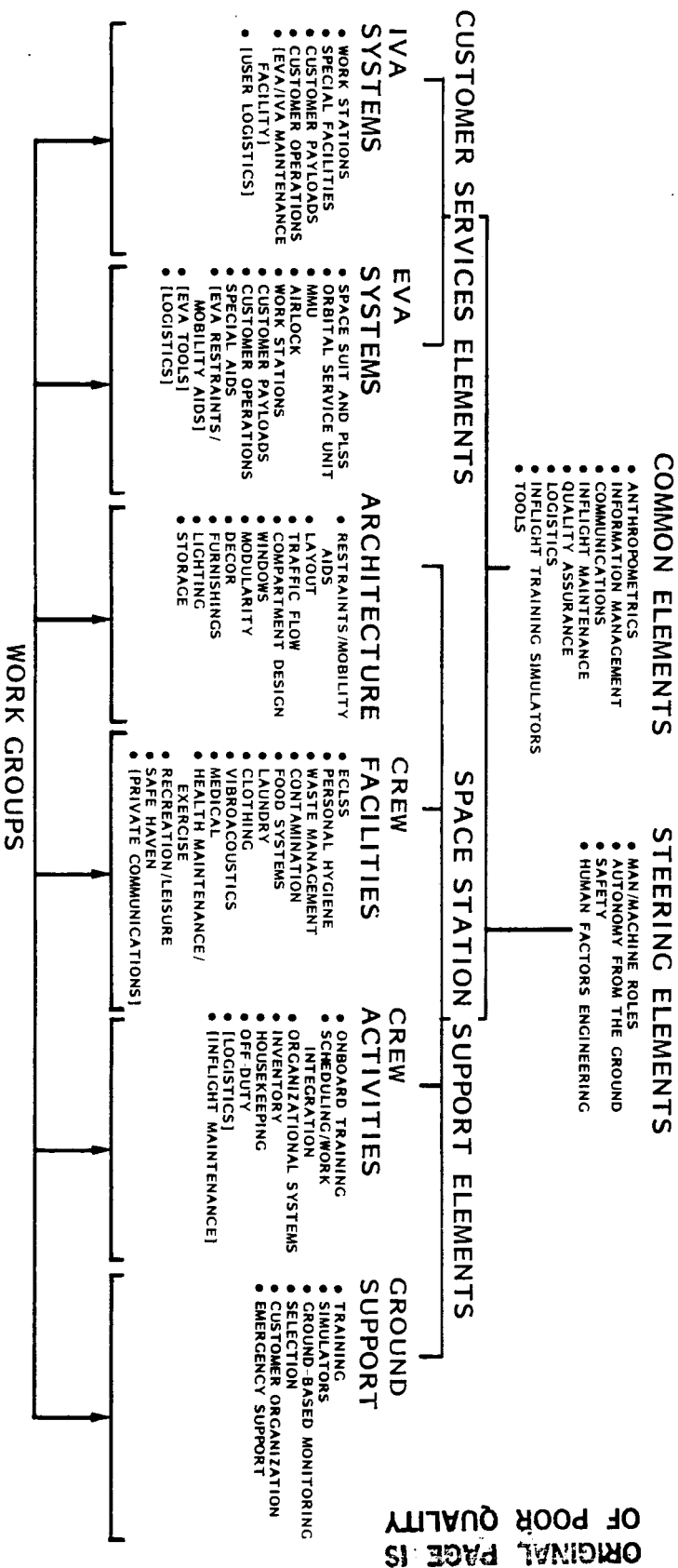


**SPACE
STATION**

TASK 1 - IDENTIFY DESIGN RECOMMENDATIONS

Human Productivity Study

1.2 IDENTIFY SPACE STATION ELEMENTS AFFECTING HUMAN PRODUCTIVITY



HUMAN PRODUCTIVITY DEFINED

In order to develop criteria which could act as guidance for evaluating and selecting Space Station elements that affect crew productivity, an operational definition of Human Productivity was formulated. The definition shown is adapted to the Space Station program from the typically-stated goals of Human Factors specialists for supporting crew performance.



HUMAN PRODUCTIVITY DEFINED

Human Productivity Study

FOR SPACE STATION

SUSTAINED PERFORMANCE OF ALL ASSIGNED CREW
FUNCTIONS IN A TIMELY, ACCURATE MANNER WITH
SUSTAINED QUALITY THROUGHOUT THE ASSIGNED
FLIGHT DURATION, AT THE LEAST FEASIBLE COST.

CREW PERFORMANCE SUPPORT NEEDS (Chart 1 of 2)

A team representing the disciplines of Human Factors, Systems Engineering, and Industrial Psychology was formed to assess what the top-level needs are, in order to provide adequate support for the defined crew performance. This assessment led to the formulation of nine broadly-defined "crew performance support needs", shown in the 2 charts that follow.

Stress was placed on the use of simplified language and the intent to incorporate diverse but directly relevant concerns.



SPAGE
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CREW PERFORMANCE SUPPORT NEEDS (CHART 1 OF 2)

Human Productivity Study

1. PHYSICAL HEALTH - ASPECTS OF LIFE AND FITNESS SUPPORT WHICH COULD CONTRIBUTE TO THE DEFINED CREW PERFORMANCE.
2. PSYCHOLOGICAL HEALTH - INCLUDING SUCH THINGS AS SENSE OF SECURITY, PERSONAL FREEDOM, AND AN ADEQUATE SOCIAL ENVIRONMENT.
3. MOTIVATION - ASPECTS OF DESIGN AND OPERATIONS WHICH COULD ACT TO SUPPORT MOTIVATION.
4. ACCESS - BOTH VISUAL AND PHYSICAL ACCESS WITHIN THE ZERO-G ENVIRON.
5. INFORMATION/KNOWLEDGE - INCORPORATING REAL TIME STATUS & FEEDBACK AND KNOWLEDGE GAINED THROUGH TRAINING & DOCUMENTATION.

CREW PERFORMANCE SUPPORT NEEDS (Chart 2 of 2)



**SPACE
Station**

CREW PERFORMANCE SUPPORT NEEDS (CHART 2 OF 2)

Human Productivity Study

6. ORGANIZATIONAL STRUCTURE - ASPECTS OF ORGANIZATIONAL CONSIDERATIONS
WHICH SUPPORT THE NEEDED DYNAMICS OF A FAVORABLE TEAM EFFORT.
7. TOOLS AND EQUIPMENT - PROVISION AND DESIGN OF ITEMS NEEDED TO PERFORM
TASKS, RELATING TO TYPICAL HUMAN ENGINEERING CONCERNS.
8. PERFORMANCE CAPABILITIES - STRESSING CAPABILITIES AND COMPATIBILITY
RELATED TO SELECTION FOR THE PROGRAM, MISSIONS AND CREW.
9. STABILITY IN ZERO-G - ASPECTS OF RESTRAINTS AND ORIENTATION (PHYSICAL
AND VISUAL) WHICH CONTRIBUTE TO STABILITY NEEDS.

CREW PERFORMANCE SUPPORT NEEDS

Each defined need was analyzed into its component parts. This served to refine the definition and to provide sufficient criteria for study team members to evaluate whether a candidate Space Station element was or was not in scope for the study. A contractor team meeting was held to confirm a common understanding of the criteria and to develop firm guidelines for all team members.

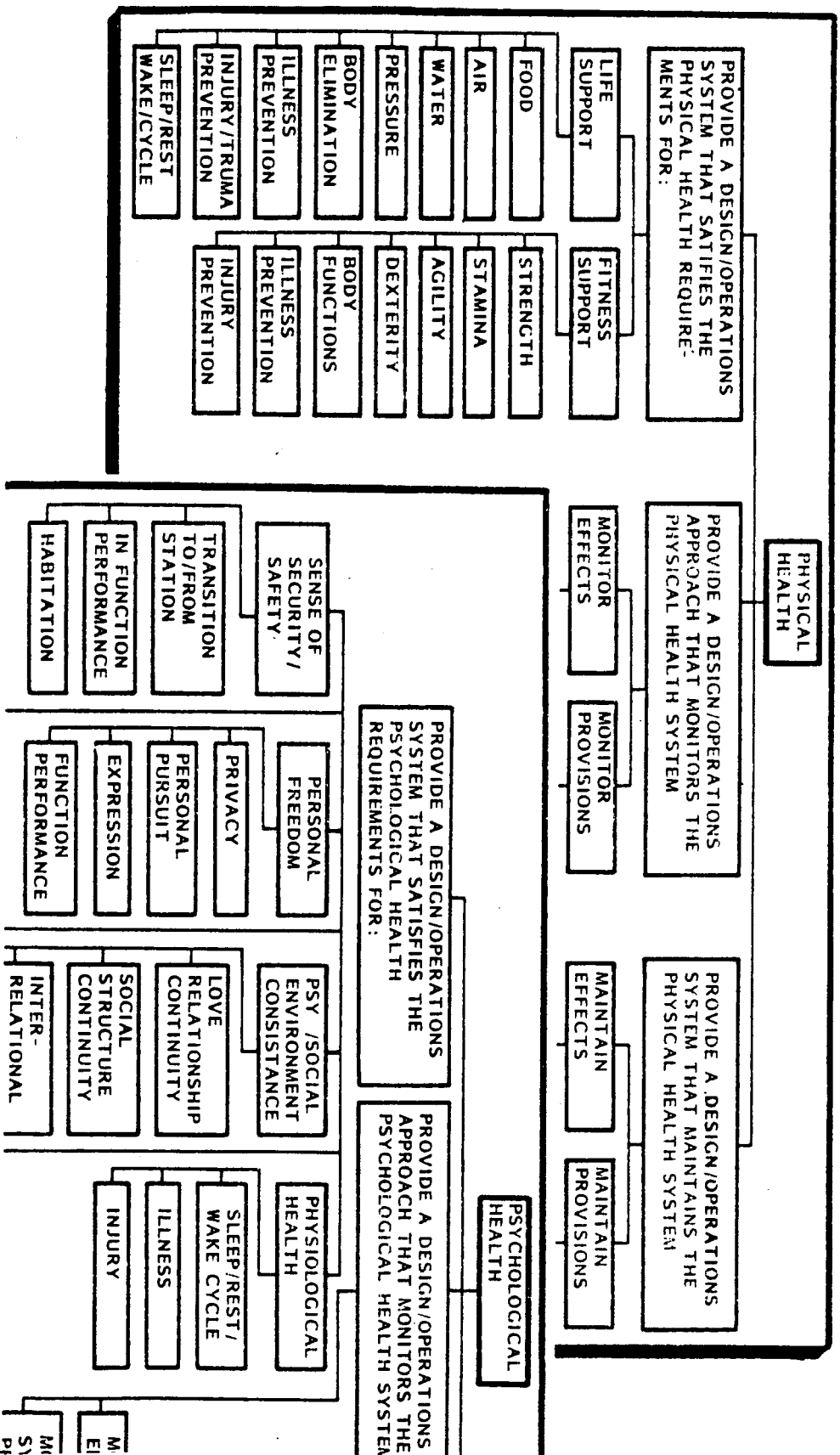
This chart shows representative examples of the method of subdividing the support needs.



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CREW PERFORMANCE SUPPORT NEEDS

Human Productivity Study



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SPACE STATION ELEMENTS AFFECTING CREW PERFORMANCE

Utilizing the described definition and evolved guidance, a final list of 48 elements was generated. The elements were categorized into the five groups shown in this chart.



**SPACE
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SPACE STATION ELEMENTS AFFECTING CREW PERFORMANCE

Human Productivity Study

INTERIOR ARCHITECTURE

- GENERAL LAYOUT
- TRAFFIC FLOW
- DECOR
- MATERIALS
- ANTHROPOMETRY
- MODULARITY
- WINDOW/REMOTE VIEWING
- STOWAGE/STORAGE

CREW SUPPORT

- INTERNAL ENVIRONMENT
- EXTERNAL ENVIRONMENT
- INDUCED ENVIRONMENT
- AREA LIGHTING
- ACOUSTICS
- SAFETY
- HEALTH MAINTENANCE
- MEDICAL CARE
- RECREATION
- PERSONNEL HYGIENE
- FOOD/WATER SYSTEMS
- HOUSEKEEPING
- WASTE/TRASH MANAGEMENT
- SUPPLY SUPPORT
- RESTRAINT SYSTEMS
- MOBILITY AIDS
- COMMUNICATIONS
- QUALITY ASSURANCE
- CLOTHING
- VIBRATION

CREW ACTIVITIES

- CREW TRAINING
- MAINTAINABILITY
- MAINTENANCE
- SUPPORT EQUIPMENT
- ACTIVITY PLANNING/SCHEDULING
- MAN-MACHINE ROLES
- ORGANIZATION
- STATION AUTONOMY

I/A SYSTEMS

- WORK STATIONS
- DATA MANAGEMENT

I/A/EVA INTERFACE

- AIRLOCK
- SERVICING AREA
- SUPPLY SUPPORT
- STOWAGE/STORAGE
- ATMOSPHERE
- PERSONNEL HYGIENE
- TRAINING/PROCEDURES
- COMMUNICATIONS
- DATA MANAGEMENT
- MAN-TENDED

SUBELEMENT LISTING

Each Element was further subdivided into Subelements, representing topical areas for the generation of requirements. In order to organize and retain traceability throughout the study, the illustrated number coding scheme was devised. Numbers for deleted subelements were not reused.



SUBLELEMENT LIST

(GROUP
ELEMENT
SUBELEMENT)

1 INTERIOR ARCHITECTURE

101 GENERAL LAYOUT

- 10102 ACTIVITY VOLUME PER CREWMEMBER/FUNCTION
- 10104 DEDICATED VS MULTIPURPOSE SPACE UTILIZATION
- 10106 EQUIPMENT & FURNISHING REQUIREMENTS
- 10107 PHYSICAL/FUNCTIONAL ADJACENCIES
- 10108 INTER/INTRA-MODULE EQUIPMENT ORIENTATION
- 10109 GROWTH

102 TRAFFIC FLOW

- 10201 FREQUENCY OF TRANSIT
- 10202 EQUIPMENT ACCOMMODATIONS
- 10203 CONGESTION MINIMIZATION
- 10204 PASSAGE IMPINGEMENT
- 10205 EMERGENCY EGRESS/INGRESS
- 10206 CREW/EQUIPMENT TRANSLATION & HANDLING AIDS

103 DECOR

- 10301 COLOR, TEXTURE, GRAPHICS & LIGHTING
- 10302 INTERIOR DESIGN MODIFIABILITY
- 10303 CODING

104 MATERIALS

- 10400 GENERAL
- 10401 HEALTH AND SAFETY
- 10402 MAINTENANCE AND REPAIR
- 10403 DURABILITY & SUSCEPTABILITY
- 10404 AUDITORY, OLFACTORY
- 10405 ELECTROMAGNETIC

REPORT FORMAT 3.1 — DESIGN/OPERATIONS REQUIREMENTS

As requirements were generated, many areas were disclosed where additional requirements were needed, but data was not available to define them. These problem areas were documented. In many cases, candidate solutions were also documented. The latter, however, are alternatives only, and do not imply NASA sanction or substitutes for recommended study.

This chart shows the standardized requirement report format (3.1). The topical Group, Element, and Subelement are identified, followed by a cross reference to the associated paragraphs(s) of the Phase B RFP. Following the current revision data, Requirements are listed. Italicized statements (within asterisks and parentheses) highlight unresolved requirements for which further study will be pursued. A "TBD" may or may not be included. Reference Number entries provide entry numbers from a Master Reference list with specific pages, section, paragraphs within parentheses. The shown example provides no Candidate Solutions or associated Critical Assumptions.



REPORT FORMAT 3.1

DESIGN/OPERATIONS REQUIREMENTS

1

INTERIOR ARCHITECTURE

106

MODULARITY

10603

EXISTING STANDARDS AND CONVENTIONS

CROSS REFERENCE TO RFP PARAGRAPH NO: C-4(2.1.5;2.2.10.1)

Revised:

9/23/85

REQUIREMENTS

REFER. NO.

-01 **(Design equipment racks per 18D criteria to provide flexibility in various module configurations.)**

145(p 2-5)

-02 Equipment racks shall accommodate a standard 19 inch (single) and 38 inch (double) width (48.26 cm and 96.52 cm).

143(p 7-5,
pp. 7.1.3.2)
144(p 3-84,
pp. 3.4.1,
1.1), 145

-03 **(Provide standardized utility interfaces in modular design.)**

144(p 3-84,
pp. 3.4.1.2, 3.4.1.3, 3.4.1.4), 145

CANDIDATE SOLUTIONS

REFER. NO.

None

1

CRITICAL ASSUMPTIONS

REFER. NO.

None

* An "ISSUE" has been defined for study to confirm or complete definition of this preliminary requirement.

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REQUIREMENTS REVIEW TEAM

Requirements were subjected to iterative reviews by NASA, then were integrated to produce the Requirements, Volume III of this Final Report.

Strong appreciation is expressed to the team of NASA reviewers listed, for assistance they provided in this very painstaking task.



SPACE
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REQUIREMENTS REVIEW TEAM

Human Productivity Study

AMES RESEARCH CENTER

R. BRETOI
M. JUNGE

MARSHALL SPACE FLIGHT CENTER

J. STOKES

JOHNSON SPACE CENTER

P. BAHR
A. BEHREND
C. BOOHER
W. LANGDOC
R. HERMLING
A. HOLLAND
J. LEWIS
F. MOUNT
J. QUELLAR
C. WHEELWRIGHT
CREW STATION DESIGN SECTION
HMF WORKING GROUP

SYSTEM-LEVEL CRITICAL ASSUMPTIONS (Chart 1 of 2)

It was necessary to make assumptions about the design and/or operations of the Space Station in order to define many requirements. All such broad impact critical assumptions were identified as "system level" and documented. Other subelement-unique critical assumptions were also needed, and these were documented with appropriate requirements. Assumptions needed to support selected Issue study approaches and their Management Plans were documented as well.

Fixed Space Station Program milestones were needed for a common approach in scheduling Management Plan subtasks. The milestone dates shown were selected with NASA coordination in May 1985, and therefore may not reflect current scheduling.

The assumption concerning EVA-suited entry to the habitable modules is a basis for requirements concerning related access and clearance within the normally pressurized modules.



SYSTEM-LEVEL CRITICAL ASSUMPTIONS (CHART 1 OF 2)

Human Productivity Study

- SPACE STATION, MANNED, IS AS DESCRIBED IN PHASE B RFP REFERENCE CONFIGURATION, WITH CREW OF SIX. SEE JSC-19989, AUG 84.

- PHASE B MILESTONES ARE:

CSD	19 APRIL 85	SDR	17 NOV-1 DEC 86
RUR 1	3-19 JUL 85	EOC	18 JAN 87
RUR 2	4-18 OCT 85	ATP(PHASE C/D)	18 APR 87
IRR	3-17 JAN 86	PDR	18 APR 88
SRR	7-21 MAR 86	CDR	18 APR 90
ISR	1-15 JUL 86		

- EMU-SUITED ACCESS WITHIN THE HABITABLE MODULES WILL BE ONLY FOR REGAINING AN ENVIRONMENT FOR SAFE IVA ENTRY, E.G., FOR LEAK REPAIR AND ECLS SYSTEM (PRESSURE, CONTAMINATION CONTROL) REPAIR. MINIMAL DEPRESSURIZED ENTRY MAY ALSO BE REQUIRED AT MODULE DEPRESSURIZATION FOR GROWTH, I.E., FOR ATTACHING ADDITIONAL MODULES.

SYSTEM-LEVEL CRITICAL ASSUMPTIONS (Chart 2 of 2)

Critical assumptions concerning the man-tended mode of operation were made early in the program. Discussions led to the decision to assume a non-pressurized environment. Thus, the man-tended mode requirements in Group 5, coded 55XXX, are applicable only if the assumption holds true. If the man-tended module is pressurized, all other Group 1 through 4 (IVA) requirements remain applicable as appropriate.



**SPACE
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SYSTEM-LEVEL CRITICAL ASSUMPTIONS (CHART 2 OF 2)

Human Productivity Study

- SPACE STATION, MAN-TENDED, IS AS DESCRIBED IN PHASE B REFERENCE CONFIGURATION (SEE 7TH PARAGRAPH, PAGE 5 OF JSC-19989) AND RFP PAGE C-5-11, PARA 2.4.
- THE MAN-TENDED STATION (LAB MODULE) IS NON-PRESSURIZED.
(RELEVANT ONLY TO SUBELEMENTS 55XXX.)
- MAN-TENDED OPERATIONS WILL BE SUPPORTED BY AN STS CREW LIVING ON THE SHUTTLE.
- THE MAN-TENDED MODULE WILL BE REOUTFITTED FOR MANNED IOC.
(REQUIREMENTS DO NOT INCORPORATE CONSIDERATIONS FOR CONVERSION TO A PRESSURIZED MODULE.)

Because the man-tended module will be pressurized the IVA requirements within Groups 1 through 4 are applicable to both man-tended and nominal options. Section 55XXX is applicable to non-pressurized work areas.

MASTER REFERENCE LIST

The master reference list documents all data sources directly utilized in the generation of requirements during the study. The listing provides an entry number and subelement identifier as to where the subelement is used. Requirements cross reference to the master list entry number.

The third subtask called for defining criteria utilized to assess the importance of Issues in Task 3. The definition was performed under this task but is described under Task 3.



MASTER REFERENCE LIST

11 August 1985

MASTER #	WHERE USED	REFERENCE
134	50101 50104	Rockwell International, <u>Requirements/Definition Document, Airlock Support</u> , Contract NAS 9-14000, SD72-SA-0106-4, 15 Jun 1976
135	10104 10201 10107 30701 30903	McDonnell Douglas Astronautics Co., <u>Thuris (Generalizations on Human Roles in Space)</u> Vol III, MDC H1295, Huntington Beach, CA, Oct 1984
136	10109	NASA-JSC, <u>Space Station Program Description Document, Book 5 Appendix B, Systems Operation</u> , Aug 1983
137	10303 10205 10206	NASA-MSFC, <u>"Mobility & Restraint," Habitability Data Handbook Vol. I</u> , MSC-03909, Alabama, 31 Jul 1971
138	10204 10302 10303 21503 21504 30105	W. Pogue, <u>Astronaut Primer</u>
139	10205 10501	M.E. Woodson, <u>Human Factors Design Handbook</u> , 1981
140	10302	NASA-MSFC, <u>"Architecture & Environment," Habitability Data Handbook Vol 2</u> , MSC-03909, Alabama, 31 Jul 1971
141	10303	NASA-JSC, <u>Crew Station Specifications</u> , JSC-07387B, Houston, TX, Jan 1982
142	10403 55104	NASA-MSFC, <u>Factors Affecting the Interior Design of Crew Compartments for Long Duration Space Flight</u> , MSC Internal #68-ET-16, Alabama, 15 Sep 1967
143	10603	NASA-JSC, <u>Space Shuttle System Payload Accommodations</u> , Vol XIV, Rev. H, JSC-07700, Houston, TX, 16 May 1983
144	10603	NASA-JSC, <u>Space Shuttle System Payload Accommodations</u> , Vol XIV, Rev. H, Attachment 1, JSC-07700, Houston, TX, 16 May 1983

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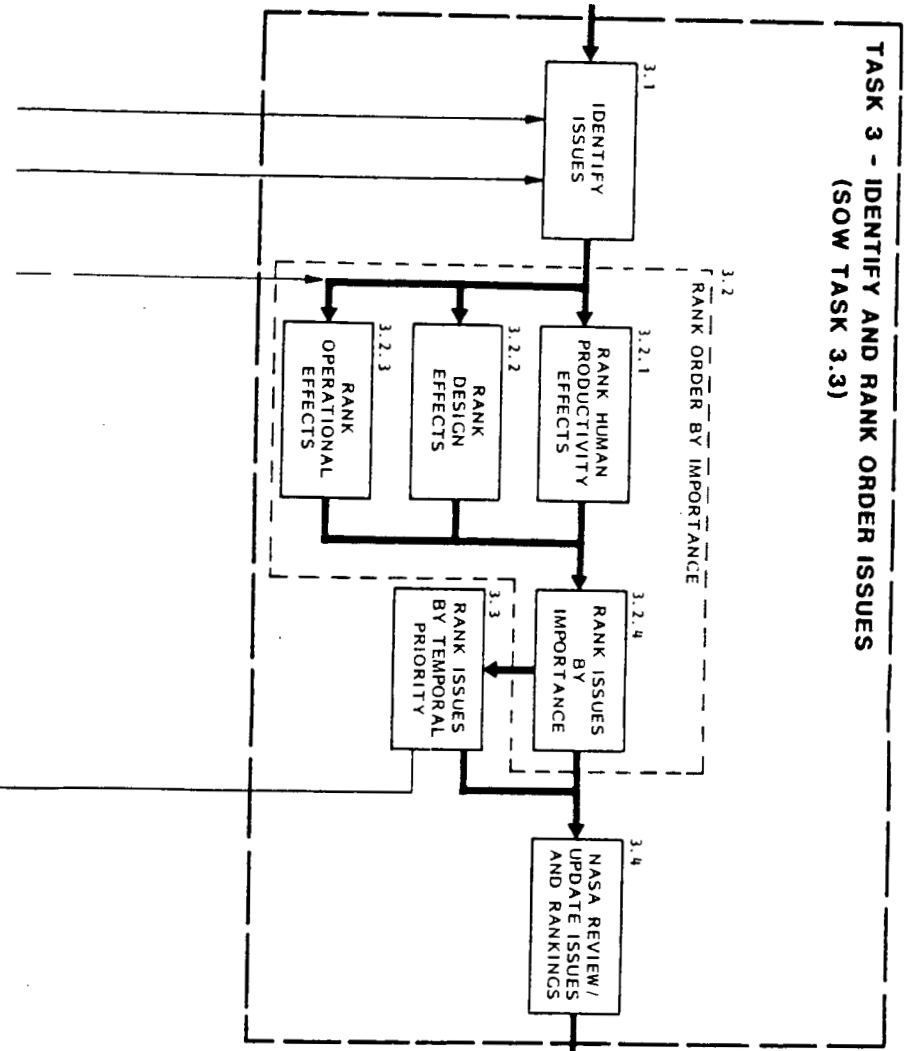
TASK 3, IDENTIFY AND RANK-ORDER ISSUES

The Issues represent consolidated descriptions of needed study topics, drawn from the problems associated with unresolved requirements. The task called for ranking Issues by Importance. This was accomplished by separately ranking each Issue according to its estimated effect on Design, Operations, and Crew Performance. The study team was then asked to rank Issues according to Space Station Program (SSP) need date (earliest to latest need to achieve timely impact). Finally, a NASA review and update of Issues and rankings was called for in Subtask 3.4.



TASK 3

Human Productivity Study



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PROBLEMS/ISSUE IDENTIFICATION

An initial set of 450 Issues for Element Groups 1 through 4 (IVA) was defined. These were thoroughly reviewed by the NASA-Contractor study team, who consolidated the list to 214 meaningful study topics.

This chart shows an example of the standardized format. The Issue title and description may encompass one or more unresolved requirements, cross referenced in the right column. For example, Issue 1010801 describes a study need relating to Requirement Statement 10108-01 (on Format 3.1).

Initiation of the Group 5 (IVA/EVA Interface) Requirements and Issues was delayed. The expected degree of coordination with the Advanced EVA System Design Requirements Study (RFP 9BE2-72-4-37P) was not possible. Hence, the Requirements and Issues generated for this study within Group 5 remain preliminary until the needed coordination is accomplished. With the addition of the preliminary Group 5 Issues, the total set numbers 305.



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PROBLEMS/ISSUE IDENTIFICATION

Human Productivity Study

FORMAT 5

PROBLEMS/ISSUE IDENTIFICATION

SUBELEMENT #

TITLE

10108

INTER/INTRA-MODULE EQUIPMENT ORIENTATION

ISSUE #

ISSUE TITLE

REQUIREMENT(S)

1010801

MODULE/ACTIVITY AREA ORIENT'N STANDARD

-01

Optimum space/volume utilization for
equip. orientation vs a 1-g orientation
is an issue to be resolved. Differing
orientation between modules or activity
areas enhances volume utilization but
disturbs crew members. Study is needed
to evolve specific crew disorientation
criteria to allow trade-offs so that
space utilization can be maximized and
to trade-off against the stated Phase B
requirement that intra-module doors/
hatches will not require body
reorientation.

ISSUES REVIEW TEAM

This chart shows the NASA-Contractor team that performed the iterative review of Issues, resulting in a final listing of 214 Issues.



**SPACE
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ISSUES REVIEW TEAM

Human Productivity Study

JOHNSON SPACE CENTER:

A. BEHREND
R. GERLACH
J. LEWIS
F. MOUNT
J. QUELLAR
J. SMOTHERMAN
B. WOOLFORD

AMES RESEARCH CENTER:

C. COLER
M. JUNGE
M. KAISER

LOCKHEED MISSILES & SPACE COMPANY:

H.T. FISHER
S. GARRITY
W. GONZALEZ*
J. SEMINARA

CAMUS:

G. CARR
B. POGUE

NASA HEADQUARTERS:

B.J. BLUTH

SUNDBERG-FERRAR INC.:

E. ECHTERLING

ADVANCED TECHNOLOGY INC.:

R. FARRELL

ILC SPACE SYSTEMS:

R. MAY

BOEING AEROSPACE COMPANY:

K. MILLER

*DID NOT PARTICIPATE IN ISSUE RANKING

ISSUE SCORING GUIDANCE

An assessment of the relative importance of all Issues was performed by estimating the potential effect of each on three areas of concern: Crew Performance, Design, and Operations. Criteria for this assessment were defined and standardized for uniform application, based on a scoring scheme. The scoring guidance (see chart) was supplemented by standardized written instructions and discussion. Note that impact estimates could be either in a positive or negative direction.



**SPACE
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ISSUE SCORING GUIDANCE

Human Productivity Study

DESIGN IMPACT	1	2	3	4	5
WEIGHT + -	0-1 lb	2-25 lbs	26-75 lbs	76-100 lbs	> 100 lbs
POWER + -	0-99 w	100-500 w	501-1000 w	1,01-2 Kw	> 2 Kw
VOLUME + -	0-2 ft ³	2.1-3 ft ³	3.1-4 ft ³	4.1-5 ft ³	> 5 ft ³
CONFIGURATION (affects design of:)	Installed equipment configuration	Compartment arrangement	Module interior arrangement	Module exterior envelope or interconnect	Any combina- tion of config- uration affects

OPERATIONS IMPACT	1	2	3	4	5
* SS CREW WORK TIME + -	0-15 MTN	15.1-30 MTN	30.1-45 MTN	45.1-60 MTN	1 HOUR
* GROUND CREW WORK TIME + -	0-2 HRS	2.1-4 HRS	4.1-6 HRS	6.1-8 HRS	8 HOURS
FUNCTION COMPLEXITY + -	NIL TO LOW	LOW TO MOD	MODERATE	MOD TO MAJOR	MAJOR

*Average per work day

C.P. IMPACT	1	2	3	4	5
POTENTIAL, POSITIVE OR NEGATIVE EFFECT	Nil or Low	Low to Medium	Medium or Moderate	Medium to Very High	Very High, Significant

ISSUE SCORE-RANKED LISTINGS

The results of the scoring process produced three separate ranked listings (see chart). Varied compilations of these rankings provided (and will continue to provide) a tool for NASA in planning performance of the associated studies.

The second part of this task called for a separate ranked listing of Issues according to temporal priority. Such a listing was generated for the initial list of 450 Issues, based on the estimated SSP need dates. As the study evolved, however, other considerations took precedence over the rationale calling for this ranking. The ranked listing, therefore, has not been updated.



Human Productivity Study

ISSUE TITLE

12010202	MAINTAIN/TEST PORTABLE H2O PURITY
12020202	SICK CHEMOTHERAPY BIOISOLATION RUMTS
12030202	OM-80802 MEDICAL BIOISOLATION RUMTS
12060102	MISSION LENGTH REQUIREMENT
12060102	STANDARD HARDWARE AND INTERFACE RUMTS
12010101	ATMOSPHERE SPECIFICATION
12020101	OPTICAL SHIELDING DISTRIBUTION
12030101	MICROMETEORITE & DEBRIS PROTECTION
12030103	ZERO-6 EQUIPMENT NOISE STANDARDS
12030202	LONG DURATION O-6 NOISE EXPOSURE LIMITS
12040104	ANIMAL PATHOLOGIS BIOISOLATION RUMTS
12100101	HUMBER & LOG. OF COMMODE/ANIMAL UNITS
12100801	FLUID SYSTEM VERIFICATION
12100801	MODUL/ACTIVITY AREA ORIENT'N STANDARD
12020401	INTERIOR VOLUME REARRANGEMENT RUMT
12020401	HAZ PARTICULATE PROTECTION FEASIBILITY
12020101	HAZ SHIELDING STRATEGY FOR GROWTH
12050101	LOW FREQUENCY NOISE CONTROL
12070104	ZERO-6 SPORTS AND GAMES
12080302	DIAGNOSTIC CAPABILITY CRITERIA FOR GROWTH
12080302	TREATMENT CAPABILITY CRITERIA FOR GROWTH
12090201	FACILITY FOR GROOM RECREATION
12100202	SHOWER USE REQUIREMENTS
12120501	WASHER/DRYER DESIGN
12120601	DISHWASHER DESIGN
12130101	WASTE/URASH PREDICTION MODEL
12130101	WASTE/URASH MONITORING
12130202	WASTE/URASH COLLECTION METHODS
12130601	URASH COMPACTOR REQUIREMENTS
12130701	CONTINGENCY URASH DISPOSAL METHOD
12140201	SPACE COMPATIBILITY W/SS SYSTEM
12140201	INVENTION MANAGEMENT SYSTEM DEVELOPMENT
12180301	ON-ORBIT FLUID SYSTEMS COMMAN. CONTROL
12190101	ITV UNDERGARMENT DESIGN
12190204	ITV UNDERGARMENT DESIGN
12190301	TOTAL QUANTITY OF CLOTHING PROVIDED
12300101	SUITED IVA CONTINGENCY OPS
12300102	WALL ACCESS/REPAIR
12300301	CUSTOMER ORU DESIGN STDS
12300302	LEVEL OF ORU
123040101	MAINTENANCE WITHOUT SHUTDOWN
123040101	AUTOMATED TECH SELECTION/TIME PHASING
12100201	MINIMUM ACTIVITY AREA VOLUME RUMTS
12100401	MULTI-USE VS DEDICATED SPACE CRITERIA
12100701	COMPARTMENT/AREA ADJACENCY CRITERIA
121020101	STAFFIC FREQUENCY DETERMINATION
121050201	ANTHROPOCENTRIC PLANE ACCOMMODATIONS
12106201	WINDOW MAINTENANCE AND PROTECTION RUMTS
12109301	FOOD/GALLEY SHELTER STORAGE REQUIREMENTS
12109601	URASH-WASTE STORAGE/COMFEG.
12200303	STORAGE VOLUME & COMFEG. RUMTS FOR GROWTH
12200303	CONFIRMATION LIMITS
12200104	WINDOW RADIATION PROTECTION

MEAN : 31

ISSUE #	ISSUE TITLE
12100201	INVENTORY MANAGEMENT SYSTEM DEVELOPMENT
12100401	MAINTENANCE WITHOUT SHUTDOWN
12100601	STANDARD HARDWARE AND INTERFACE ROLLS
12100801	CONDUIT DESIGN REQUIREMENTS
12101001	INTERNAL DESIGN REQUIREMENTS
12101201	CUSTOMER TECH DESIGN AIDS
12101401	SHIFT OPTIONS
12101601	LABORATORY TECH SELECTION/TIME PHASING
12101801	REGISTRATION LOCATIONS CRITERIA
12102001	COLOR, LABEL & PATTERN CODING CRITERIA
12102201	STORAGE CATEGORIZATION
12102401	FOOD WASTE HANDLING
12102601	SPARES COMPATIBILITY W/SS SYSTEM
12102801	LOCATION OF ON-BOARD SPARES
12103001	LEVEL ACCESS/REPAIR
12103201	LEVEL OF ORU
12103401	SUPPORT EQUIPMENT DESIGN STANDARDS
12103601	REQUIREMENT OF ON-BOARD TOOLS
12103801	HYDRAULIC LIFT & TIGHTENING CONJONES
12104001	LOGIC/ANALYTICAL STORAGE
12104201	TRAFFIC REQUIREMENT DETERMINATION
12104401	TEVA AND MAINTENANCE ACCOMMODATIONS ROLLS
12104601	INTERIOR VOLUME REARRANGEMENT ROLLS
12104801	FRASH-WASTE STORAGE/STORAGE
12105001	DATA FILE STORAGE REQUIREMENTS
12105201	NUMBER & LOC. OF CONDUIT/INTERNAL UNITS
12105401	AUTOMATIC FOOD INVENTORY SYSTEM
12105601	MICROBIAL STABILIZATION TECHNIQUES
12105801	MODULE DOCKING AIDS
12106001	STANDARDIZED FOODCART/FOOT RESTRAINT SYS
12106201	EQUIPMENT RESTRAINTS
12106401	TECH TRANSLATION AIDS
12106601	TECH TRANSLATION AIDS
12106801	ON-ORBIT OJT TRAINING COST & BENEFITS
12107001	CRITICAL TASK CROSS-TRAINING
12107201	MAINTENANCE WORKSTATION
12107401	VARIED CREW SCHEDULE MODELS
12107601	ON-BOARD TASK TRAINING TIME
12107801	FAST VERIFICATION AT WORKSTATIONS
12108001	MULTI-USE VS DEDICATED SPACE CRITERIA
12108201	MODULE/ACTIVITY AREA ORIENT 'N STANDARD
12108401	INTERIOR LOCATION COORDINATE SYSTEM
12108601	FAMPHORNET/INTERNAL NAME ACCOMMODATIONS
12108801	FOOD/ALLEY SHELVE STORAGE REQUIREMENTS
12109001	STORAGE VOLUME & CONF. ROLLS FOR GROWTH
12109201	EXERCISE TIME ROLLS
12109401	INDIVIDUAL VS BULK FOOD PACKAGE ROLLS
12109601	HOUSEKEEPING EQUIPMENT
12109801	WASTE/FRASH COLLECTION METHODS
12110001	WASTE/FRASH INTRANSFER CONT
12110201	CONTINGENCY FRASH DISPOSAL METHOD
12110401	FOOD RESTRAINTS
12110601	FRAGILE CONTROL PARTS INSPECT. CRITERIA

MEAN : SD

CREW PERFORMANCE			
ISSUE #	ISSUE TITLE	MEAN	SD
10104001	MULTI-USE VS DEDICATED SPACE CRITERIA	5.00	0.714
10104001	COMFORT/AREA ADEQUACY CRITERIA	5.00	0.448
10104001	INDICATE/ACTIVITY AREA VARIATION STANDARDS	5.00	0.419
10104001	STANDARD HANDRAIL AND INTERFERENCE CRITERIA	5.00	0.448
12050102	LOW FREQUENCY NOISE CRITERIA	5.00	0.448
12100101	TECHNOLOGY DESIGN REQUIREMENTS	5.00	0.416
12100101	STANDARDIZED FORMS/PROF. RESISTANT SYS	5.00	0.764
13000107	PRODUCTIVITY FACTORS	5.00	0.335
13000107	PRODUCTIVITY DESIGN GUIDELINES	5.00	0.335
13000107	PREDICTION OF LOW FREQUENCY NOISE	4.67	0.911
13000107	PERF-G EQUIPMENT NOISE STANDARDS	4.67	0.362
13000107	THROW DURATION 0-6 MINUTE EXPOSURE LIMITS	4.67	1.079
13000107	JURINAL DESIGN REQUIREMENTS	4.67	0.404
13000107	WASTE WASTE HANDLING	4.67	0.524
13000107	PARTIAL-ANDY CLEANING AIDS	4.67	0.705
13000107	INVENTING MANAGEMENT SYSTEM DEVELOPMENT	4.67	0.319
13000107	TRAINING PERFORMANCE CRITERIA	4.67	0.318
13000107	SMALL GROUP SYSTEMS	4.67	0.438
13000107	SHIFT EFFECTS ON PERFORMANCE	4.67	0.404
13000107	ORGANIZATIONAL STRUCTURE	4.67	0.524
13000107	METHODS TO ENHANCE CREW TEAMWORK	4.67	0.591
10104001	INITIATING ACTIVITY AREA VARIATION STANDARDS	4.67	0.000
10503201	INTERPERSONAL RANGE ACCOMMODATIONS	4.67	0.786
10503201	METAL BODY POSTURE DATA DEVELOPMENT	4.67	0.650
10700401	WINDOW MAINTENANCE AND PROTECTION AIDS	4.67	0.685
10900101	STORAGE CONFIGURATION	4.67	0.381
10900101	WASTE-WASTE STORAGE/STORAGE	4.67	0.698
12070103	PERF-G AERODIC EXERCISES	4.67	1.067
12070301	WATERAL PATIWAYS BIOLOGICAL RUMTS	4.67	0.591
12094002	INTELLIGENCE FOR INDIVIDUALIZED RECREATION	4.67	0.591
12140202	INDIVIDUAL DIRECTION AIDS	4.67	0.419
12140202	LOCATION OF ON-BOARD SPACES	4.67	0.816
12150201	PLANT RESISTANTS	4.67	0.657
12150301	CABLE & MOUSE MANAGEMENT	4.67	0.591
12150303	EQUIPMENT STATUS MARKING ON-BOARD	4.67	0.167
13001013	DEPTH OF SYSTEM FUNCTION TRAINING	4.67	0.085
13001013	LOW-ORBIT ALT TRAINING COST & BENEFITS	4.67	0.229
13004002	STIMULATION FIDELITY FOR ALL TRAINING	4.67	0.629
13004002	CRITICAL TASK CROSS-TRAINING	4.67	0.419
13004002	WALL ACCESS/REPAIR	4.67	0.848
13004001	MAINTENANCE MAINTENANCE	4.67	0.650
13064001	TV/EVA TASK & TRAINING CURVES	4.67	0.598
13064002	SHIFT OPTIONS	4.67	0.314
13064005	MISSION LENGTH REQUIREMENT	4.67	0.527
13064005	FAST PERFORMANCE ANALYSIS	4.67	0.591
13064010	REC/LEISURE TIME RIGHTS	4.67	0.355
13064010	DECISION MAKING TECHNIQUES	4.67	0.483
13064010	ANTIMONY TECH SELECTION/TIME PASTING	4.67	0.383
13064010	STAFFING FREQUENTLY DETERMINATION	4.67	0.416
13064010	TEVA AND MAINTENANCE ACCOMMODATIONS	4.67	0.487
13064010	WATERSTATION EVALUATIONS CRITERIA	4.67	0.444
13064010	TEVA AND MAINTENANCE ACCOMMODATIONS	4.67	0.313
13064010	INTERIOR LOCATION COMMUNAL SYSTEM	4.67	0.385

TASK 4, IDENTIFY TRADE STUDIES (Chart 1 of 2)

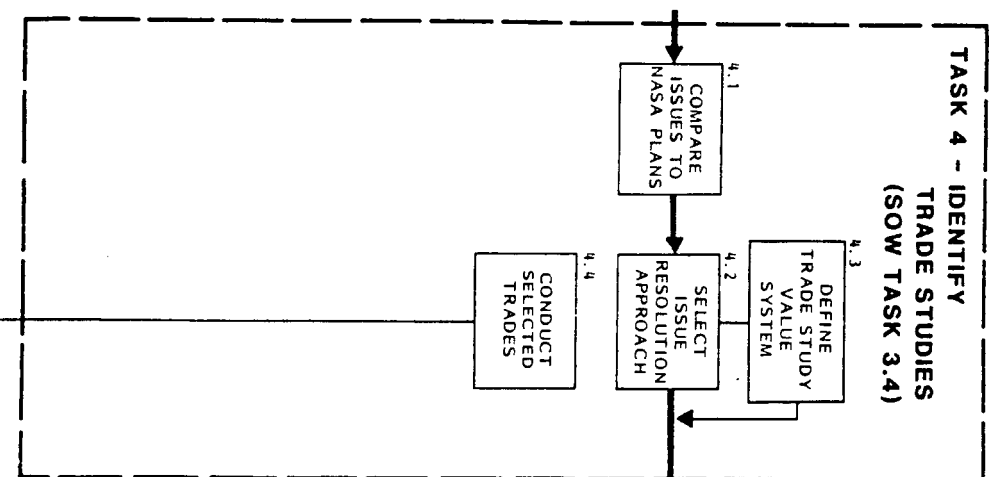
Task 4 was a mixed set of subtasks leading to the final selection of Issues for study, and the respective study approaches.



**SPACE
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TASK 4-IDENTIFY TRADE STUDIES (CHART 1 OF 2)

Human Productivity Study



TASK 4 — IDENTIFY TRADE STUDIES (Chart 2 of 2)

The first objective of Task 4 was a comparison of the selected Issues to ongoing and planned NASA studies, in order to assess potential overlaps and thus eliminate some Issues from further consideration. The effort was performed by NASA through Technical Monitor Representative Offices at Ames Research Center and at Johnson Space Center. This comparison and evaluation resulted in a final selection of prioritized Issues. A joint NASA-Contractor review led to the selection of 108 Issues for the preparation of recommended study approaches.

Multiple Issues were frequently combined to form one study plan. Selected approaches were specified for each unique study plan.

A common trade value system was not specified, but is described for each plan.

The subtask of performing selected trade studies was defined to cover the potential need to select among candidate critical assumptions. Such studies were not needed.



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TASK 4-IDENTIFY TRADE STUDIES (CHART 2 OF 2)

Human Productivity Study

4.1 NASA STUDY OVERLAP SEARCH

- **RECOGNIZED REDUNDANCIES SET ASIDE**
- **NASA-CONTRACTOR NEGOTIATION FOR ISSUE SELECTION**

4.2 STUDY PLANS COMBINED ISSUES

- **MIXED APPROACHES**

4.3 TRADE NEEDS, CONSIDERATIONS DESCRIBED WITHIN STUDY TASKS

- **TRADE VALUE SYSTEM NOT STANDARDIZED**

4.4 TRADE STUDIES NOT NEEDED; NOT PERFORMED

MANAGEMENT PLANS

A total of 67 studies (Management Plans) were formulated, covering 108 Issue topics. Based on defined study objectives and, importantly, on the time available for the study to reach completion by the estimated SSP need dates, study approaches were selected.

This chart shows a sample of the final list of Management Plans and incorporated Issues. Generic titles were chosen for study plans covering multiple Issues. The Management Plan numbering scheme retains the Element Code.



MANAGEMENT PLANS

Human Productivity Study

MCMT PLAN NO.	ISSUE NO.	TITLE
101M01	1010201 1010401 1010701 1010801	COMPARTMENT ARRANGEMENT AND VOLUME GUIDELINES MINIMUM ACTIVITY AREA VOLUME GUIDELINES MULTI-USE VS DEDICATED SPACE CRITERIA COMPARTMENT/AREA ADJACENCY CRITERIA MODULE/ACTIVITY AREA ORIENTATION STANDARD
102M01	1020101 1020301	TRAFFIC FREQUENCY AND WORKSTATION LOCATION TRAFFIC FREQUENCY DETERMINATION WORKSTATION LOCATIONS CRITERIA
103M01	1030101 1030201 1030301	INTERIOR DESIGN GUIDELINES INTERIOR DESIGN GUIDELINES INTERIOR DESIGN MODIFIABILITY PROVISIONS COLOR, LABEL, AND PATTERN CODING CRITERIA
103M02	1030302	INTERIOR LOCATION COORDINATE SYSTEM
104M01	1040001	HAB INTERIOR MATERIALS SELECTION REQUIREMENTS
105M01	1050201 1050301 1050401	ANTHROPOMETRIC DATA DEVELOPMENT ANTHROPOMETRIC RANGE NEUTRAL BODY POSTURE DATA DEVELOPMENT GROWTH AND ANTHROPOMETRIC CRITERIA
106M01	1060101	INTERIOR VOLUME REARRANGEMENT REQUIREMENTS
106M02	1060102	STANDARD HARDWARE AND INTERFACE REQUIREMENTS
109M01	1090101 1090601	EQUIPMENT AND FOOD STOWAGE; IOC AND GROWTH STOWAGE CONFIGURATION STOWAGE VOLUME AND CONFIGURATION FOR GROWTH

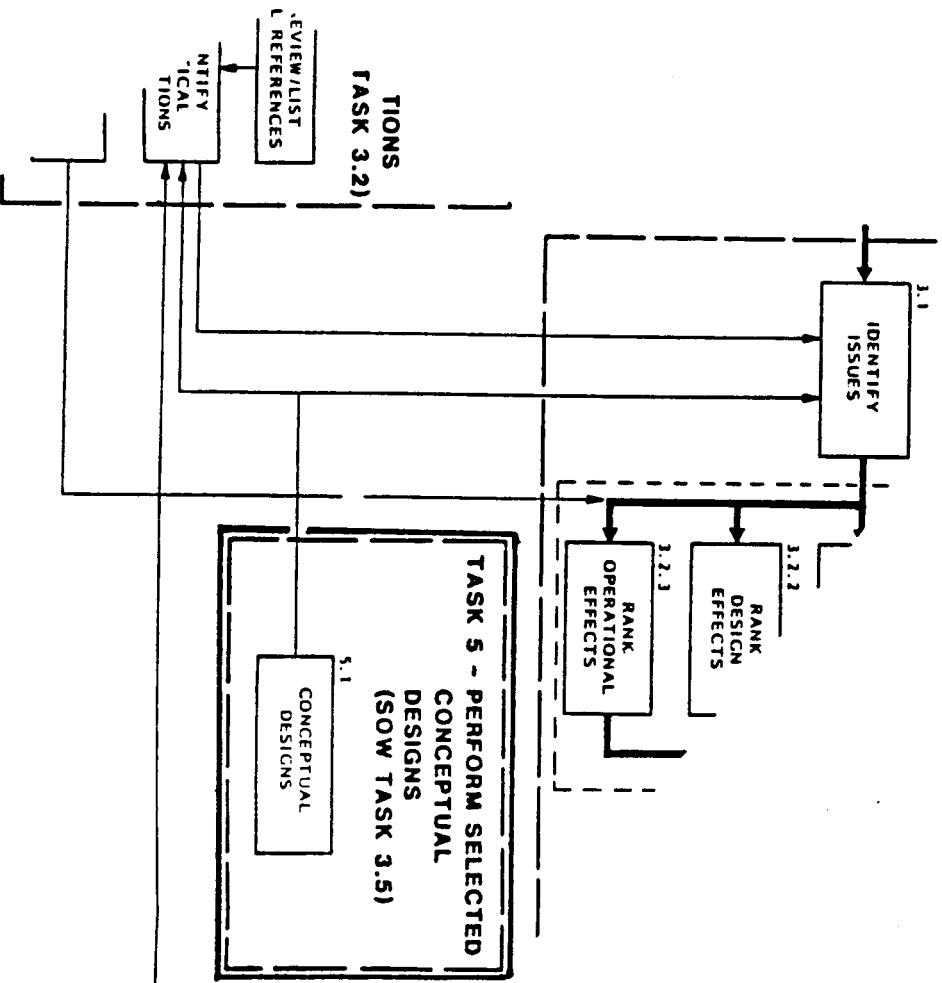
TASK 5 — PERFORM SELECTED CONCEPTUAL DESIGNS

This task was scoped for the development of design concepts which might be needed to better define problems addressed by Issues. In all cases, concepts took the form of line drawings. Where appropriate, these were included as illustrations within the Management Plans (Volume V).



TASK 5

Human Productivity Study



CONCEPTUAL DESIGNS

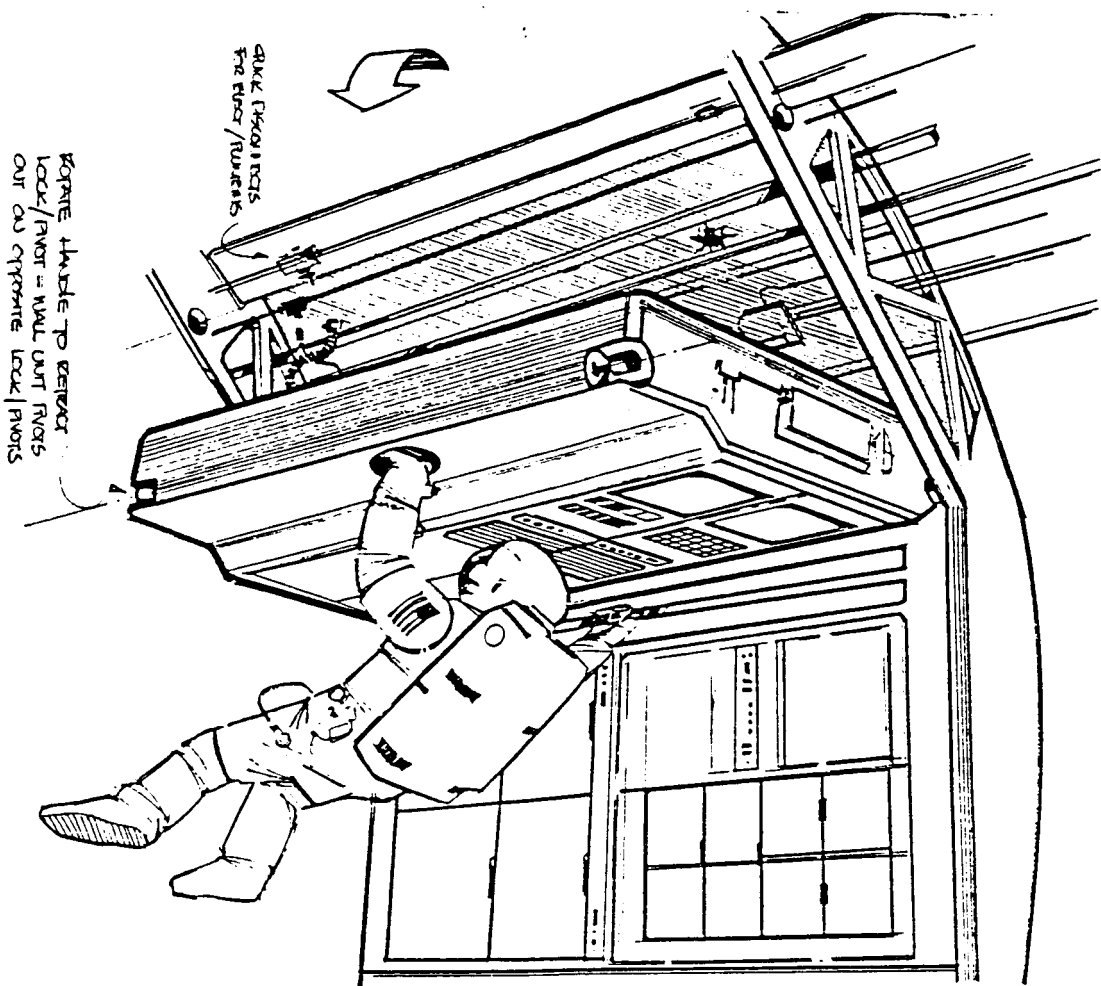
This chart shows an example of a design concept illustration, for use with a Management Plan. In many cases the problem depiction was more easily illustrated by a candidate solution, supplemented by discussion. In this example, problems associated with repair of the module shell are easier to understand by looking at the candidate solution illustration.



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CONCEPTUAL DESIGNS

Human Productivity Study



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TASK 6—DEVELOP MANAGEMENT PLANS AND DEVELOPMENTAL SCHEDULES

The Management Plans describe the recommended approaches and schedules for conducting the studies needed to resolve selected Issues. Data from these studies will enable clarification and update of the unresolved (or omitted) Requirements.

Each standardized Management Plan contains three sections:

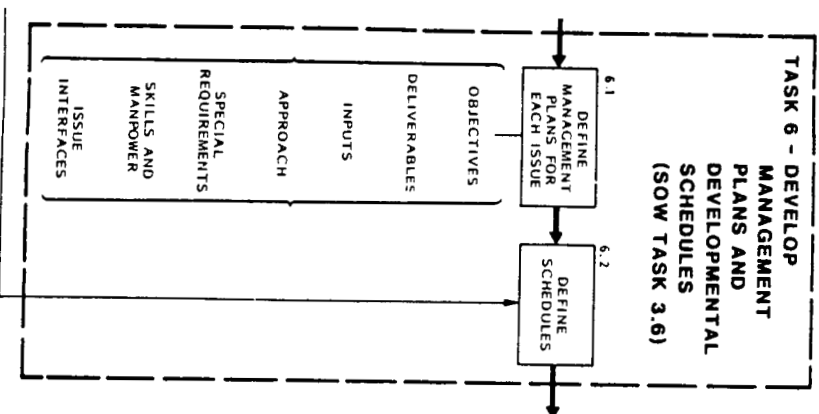
- Format 13 — Overview; providing background and summary information.
- Format 14 — Study Plan; detailing the approach by subtasks and indicating special needs.
- Format 15 — Schedule-Task Flow; providing a time line and enumeration of resources. Each study plan is independently scheduled.

Study Management Plans are contained in Volume V. The Study Description contained in Volume I provides a detailed description of all formats used.



TASK 6

Human Productivity Study



SELECTED DETAILED EXAMPLES

Four detailed examples, as shown, were presented in the Oral Review.



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DETAILED EXAMPLES

Human Productivity Study

SELECTED EXAMPLES DESCRIBED IN DETAIL
FROM DATA COMPILATION THROUGH STUDY
MANAGEMENT PLANS.

214M03	INVENTORY MANAGEMENT
201M01	ATMOSPHERE REVITALIZATION
215M01	RESTRAINT SYSTEM
101M01	GENERAL LAYOUT

STUDY PRODUCTS (Chart 1 of 2)

The Requirements comprise Volume III of this final report. The introduction and supportive material in that volume make it a stand alone document.

All Issues are contained in Volume IV. Each briefly describes a needed study topic and provides a cross reference to unresolved requirements.

The study Management Plans are contained in Volume V. As indicated studies are completed, Requirements will be updated.



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STUDY PRODUCTS (CHART 1 OF 2)

Human Productivity Study

- REQUIREMENTS DOCUMENT
 - 48 ELEMENTS
 - 226 SUBELEMENTS
 - REFERENCES AND SUPPORTIVE MATERIAL
- ISSUES
 - 305 DEFINED STUDY TOPICS
 - CROSS-REFERENCED TO UNRESOLVED REQUIREMENTS
- STUDY MANAGEMENT PLANS
 - 67 FULLY-DESCRIBED STUDY APPROACHES & RESOURCE SUMMARIES, COVERING 108 ISSUES

STUDY PRODUCTS (Chart 2 of 2)

The PC data files have been provided to NASA and have been retained at Lockheed. The architecture was previously described. These data files form the basis for the next phase of the Human Productivity Study, which is to develop a relational data base (the Human Productivity Data Management System) for SSP users.



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STUDY PRODUCTS (CHART 2 OF 2)

Human Productivity Study

● PERSONAL COMPUTER FILES

COMPLETE DATA TRACEABILITY

DISKETTE, TAPE, CRT, OR PRINTED DATA ACCESS

NETWORK ACCESS

SUPPORTIVE DATA ACCESS

(EG., MGMT PLAN - ISSUE - UNRESOLVED REQMT CORRELATION)

PREPARED FOR CONVERSION TO RELATIONAL DATA BASE

UPDATEABLE

RECOMMENDATIONS

Integration of Study Schedules

The recommended study approaches were prepared independently. As a result, schedules among different studies having input-output relationships were not integrated for appropriate chronologies. A tool for tracking this integration was provided as an input-output relationship matrix. Resolution of any disclosed conflicts could take several forms, such as:

- Delete input requirements that are not essential
- Make a critical assumption in lieu of the indicated study result
- Convene a panel of experts to formulate the stipulated input data (and decide whether to supersede the previously planned study)
- Reschedule one or both studies to achieve appropriate integration
- Alter the recommended approach(es) to condense schedules for integration

This analysis and decision process must also consider integration with other NASA-sponsored studies which negate the need to pursue described issues with study management plans. There may also be studies which could provide designated input needs but which have no corresponding issue descriptions. Increased complexity to the analysis comes from the fact that inputs may be needed at various points at and after the start of a study schedule. Also, input-output links may be formed by related studies, causing associated rescheduling requirements. Finally, SSP need dates (shown for subsumed Issues) must be revised to reflect changes of study schedules. Future revisions will be required to accommodate changes to the SSP milestone dates.

The designation of a panel is recommended to perform this complex analysis, having sufficient authority and access to information to achieve early resolution. The associated analysis and decision process should also consider various resource requirements, such as the availability of special facilities.



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RECOMMENDATIONS

Human Productivity Study

COMPREHENSIVE INTEGRATION OF STUDIES

HP (MANAGEMENT PLAN) STUDIES
EXISTING NASA STUDIES

ESTABLISH RELATIONSHIPS AND CHRONOLOGIES
IN LIGHT OF SSP TIMELY INPUT NEEDS

MANAGEMENT PLAN RELATIONSHIPS MATRIX

An extract from the Management Plan Relationships matrix is shown. This matrix provides a tool for the analysis needed to develop integrated schedules for the studies. It is noted that plans for the relational data base include means of identifying scheduling conflicts and sampling resolution approaches.

MANAGEMENT PLAN RELATIONSHIPS

TO	FROM
101M01	1010201 1010401 1010701 1010801
102M01	1020101 1020301
103M01	1030101 1030201 1030301
103M02	1030302
104M01	1040001
106M01	1050201 1050301 1050401
106M01	1060101 1060102
106M02	1060101 1060102
109M01	1090101 1090501
109M02	1090401
109M03	1090301
201M01	2010101 2010201 2010202 2010203
201M02	2010301 2010302
201M06	2010301 2010302
202M01	2020101 2020102
202M02	2020103 2020104 2020105 2020801 2021001
202M03	2020502 2020501 2020503 2020504
202M04	
202M05	

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RECOMMENDATIONS

During this study, it was disclosed that adequate information concerning the actual status of ongoing research and technology development efforts within NASA is not conveniently available in a common form or location. The Research and Technology Operating Plans (RTOS) and Project Operations Plans (POPS) do not provide this information.

It is recommended that a system be standardized which requires a NASA-wide periodic updating of this information for centralized control and dissemination. A format for this purpose is exemplified in Department of Defense Form 1498. Use of key words and appropriate coding would facilitate and make data base access, such as to the planned Technical Management Information System (TMIS), convenient for all potential SSP users.



RECOMMENDATIONS

Human Productivity Study

RESEARCH AND TECHNOLOGY DEVELOPMENT STATUSING

RTOPS AND POPS INADEQUACY

PERIODIC STATUSING OF IMPLEMENTED STUDIES

- STANDARDIZED FORMATS
- COMMON DATA BASE
- NASA-WIDE

DD FORM 1498 (EXAMPLE)

DD Form 1498 is used to report and track the status of Research and Technology efforts.



DD FORM 1498 (EXAMPLE)

Human Productivity Study

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY		1. AGENCY ACQUISITION		2. DATE OF SUBMITTAL		3. REPORT COMPLETION	
4. DATE OF SUBMITTAL		5. SUMMARY		6. SUMMARY		7. SUMMARY	
A. NEW		U		U		U	
PROGRAM ELEMENT		PROJECT NUMBER		TASK AREA NUMBER		WORK UNIT NUMBER	
62717A		20162717A790					
C. CONTINUING		STOC					
U - ASSESSMENT OF ADVANCED TERRAIN REPRESENTATION FOR BATTLE SIMULATION (Tech Base)							
13. STRUCTURE AND TECHNOLOGY ANALYSIS							
013400 Psy Ind Cp Behav 009400 Man-Machine Relat							
14. PROJECT DATE		15. ESTIMATED COMPLETION DATE		16. PROJECT NUMBER		17. PROJECT STATUS	
15, Sept, 81		August, 1984		DA		B. Contract	
18. CONTRACT/GRANT		19. MDA 903-81-C 0568		20. PROJECT STATUS		21. PROJECT STATUS	
15 Sept, 81		August, 84		81		.75	
22. SUMMARY		23. SUMMARY		24. SUMMARY		25. SUMMARY	
NEW		500 K		82		1.5	
26. SUMMARY		27. SUMMARY		28. SUMMARY		29. SUMMARY	
DA Army Research Inst (TRI)		Simulation Systems Technical Area		8400 Westpark Drive, Suite 600		McLean, VA 22101	
5001 Eisenhower Ave		Alexandria, VA 22333		John F. Patterson		(703) 821-2828	
Mitchell, N. B.		(202) 274-9420		Robert N. Kraft		Terry A. Bresnick	
23. Objective. (U) The goal of this effort is to enhance the effectiveness and efficiency of small unit battle simulation training systems through the application of advanced technology for terrain representation. A prototype terrain representation system based on the recently developed "surrogate travel" techniques which integrate videodisk, microprocessor and computer generated imagery technologies, will be developed and evaluated against conventional approaches.							
24. Approach. (U) Initial work involves an empirical analysis of the temporal and spatial resolution requirements of a "surrogate travel" system, including interaction of resolution requirements with type of terrain to be represented, mode of travel, and other variables relevant to battle simulation applications. The resulting specification of minimum structural and performance requirements for application to particular battle simulation training objectives and control functions will be used to select a specific configuration for prototype development. The prototype advanced terrain representation system will, in turn, be subjected, in a battle simulation training context, to a cost and training effectiveness analysis (CTEA) in comparison with conventional terrain representation methods, including tactical maps, map boards, and three dimensional terrain boards.							

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HUMAN PRODUCTIVITY STUDY CONTINUATION

Human Productivity Data Management System

The next phase of this study will include the development of a prototype relational data base, to be called the Human Productivity Data Management System. This will utilize the described study data files. Compatibility with long-term NASA systems and ease of user access will be emphasized. Until completion and availability of this system, results of the Human Productivity Study will remain available in hard copy.



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HUMAN PRODUCTIVITY STUDY CONTINUATION

Human Productivity Study

RELATIONAL DATA BASE DEVELOPMENT

- DEFINE USER REQUIREMENTS
- DEFINE COMPATIBILITY CONSTRAINTS
- DEVELOP ARCHITECTURE
- IMPLEMENT PROTOTYPE WITH HP DATA BASE
- PROVIDE SYSTEM, DOCUMENTATION & INSTRUCTION

INTEGRATION OF HUMAN PRODUCTIVITY AND SPACE STATION PROGRAMS

The Space Station Human Productivity Study is one element of a broader program for the implementation of human productivity considerations in the design and operation of the Space Station. In addition to an ongoing process of technical meetings and implementation of several past and future studies focused on specific issues, other key related events in the program are summarized in the schedule. The schedule relates the key milestones for the development of the Relational Data Base, and results of the recommended issue studies, to Space Station Program Milestone events. The primary milestones of the Advanced Extra-Vehicular Maneuvering Unit (EMU) Studies are shown. While a close interfacing of the HP Study with those studies was initially planned, only a preliminary interface was possible because of the shown differences in schedules and study outputs.

Another important aspect of the broad human productivity program is the Man-Systems Integration Standards study, which will synthesize and refine present study results with other available standards and specifications to generate a practical tool for Space Station Program users. Those results will be converted to a relational data base, formulated by the study described above.



Human Productivity Study

